# JaxoDraw:

# A graphical user interface for drawing Feynman diagrams

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#### Abstract

JaxoDraw is a Feynman graph plotting tool written in Java. It has a complete graphical user interface that allows all actions to be carried out via mouse click-and-drag operations in a WYSIWYG fashion. Graphs may be exported to postscript/EPS format and can be saved in XML files to be used in later sessions. One of the main features of JaxoDraw is the possibility to produce LaTeX code that may be used to generate graphics output, thus combining the powers of TeX/LaTeX with those of a modern day drawing program. With JaxoDraw it becomes possible to draw even complicated Feynman diagrams with just a few mouse clicks, without the knowledge of any programming language.

# 1 Introduction

It is a widely accepted convention today in the scientific community to write scientific papers using the TEX and LATEX environments. The high quality, publication-style typesetting of LATEX has made it now a de facto standard, to such an extent that some scientific journals only accept submission of papers in electronic form anymore. The portability goal of TEX has however the drawback that graphical representations are only possible in very rudimentary form (using the LATEX picture environment or packages using a similar approach). Useful as they are, mostly they are too simple to draw complicated Feynman diagrams as needed in wide parts of theoretical nuclear and particle physics today.

This problem has led to the development of more sophisticated programs in the past. The UK List of TEXFrequently Asked Questions<sup>1</sup> lists four possibilities to draw Feynman diagrams in conjunction with LATEX: Michael Levine's feynman [1] bundle; Jos Vermaseren's axodraw [2] package which uses PostScript specials and is thus slightly less portable but much more powerful; Thorsten Ohl's feynmf [3] package for LATEX2e which uses METAFONT (or MetaPost) to combine flexibility and portability; and Norman Gray's feyn<sup>2</sup> package. These are all available from the CTAN<sup>3</sup> archives.

Powerful as they are, all these methods have the common drawback that they require some 'hard-coding' from the user side, there does not exist any graphical user interface while modern day drawing programs do not include special options that are necessary to draw Feynman diagrams with the same quality as the one achieved by TEX/IATEX.

Our program JaxoDraw is an attempt to close that gap. As the name suggests, it was initially meant to be a graphical user interface for Jos Vermaseren's axodraw package, but it may be used independently of it. However, it is in conjunction with axodraw that JaxoDraw develops its main capabilities because of the possibility to combine the powers of TeX/IATeX with a modern drawing program. The main design goal of JaxoDraw was convenience and ease-of-use; it should be possible for anybody to draw even complicated Feynman diagrams with just a few mouse clicks, without the knowledge of any programming language. JaxoDraw was written in Java, which means that (in principle) it can be used on any platform where a Java Runtime Environment is installed. This makes it completely portable, even though in the present version, the program includes the execution of some external commands that are inherently system dependent and currently only work under certain operating systems.

This paper attempts to give a complete overview of JaxoDraw from installation and usage instructions to documentation issues and possible developments.

# 1.1 Overview

JaxoDraw is a Feynman graph plotting tool written in Java. It has a complete graphical user interface that allows all actions to be carried out via mouse point-and-click-and-drag operations. Graphs may be exported to postscript / EPS format and can be saved in XML files to be used for later sessions. One of JaxoDraw's main features is the possibility to create LATEX files which make use of J. Vermaseren's axodraw package to create a Feynman diagram via latex and dvips. It was in fact the main motivation to write JaxoDraw, to create a graphical user interface for the axodraw package.

A few of JaxoDraw's main features are:

Complete point-and-click graphical user interface.

Pre-defined line styles for common particle representations.

Saving and reading of sessions in XML format.

Export to Postscript, EPS and LATEXformat.

Setting of permanent preferences.

The home of JaxoDraw sources and documentation is: http://altair.ific.uv.es/~JaxoDraw/home.html,

<sup>1</sup>http://www.tex.ac.uk/cgi-bin/texfaq2html?label=drawFeyn

http://www.astro.gla.ac.uk/users/norman/distrib/latex/

<sup>3</sup>http://www.ctan.org/

please refer to this page for (hopefully) up to date information.

There is also a direct link to the JaxoDraw home page in the web page of the Physics Department of the University of Valencia:

http://fisteo.uv.es/catala/deptlinks.html

# 1.2 Installation

You may download JaxoDraw in three different forms (xxx denotes the version number and platform type):

```
JaxoDraw-xxx-src.tar.gz : A gzipped tar file (~0.4 Mb) containing the JaxoDraw sources

JaxoDraw-xxx-bin.tar.gz : A gzipped tar file (~0.6 Mb) containing precompiled binaries

JaxoDraw-xxx-jre.tar.gz : A gzipped tar file (~22 Mb) containing precompiled binaries

and a Java Runtime Environment
```

If you have a Java Developer Kit installed on your system and you want to compile JaxoDraw yourself from sources, you may download the src.tar.gz file above. Check the prerequisites section 1.2.1 and the compiling from sources section 1.2.3 below.

If you have a Java Runtime Environment installed on your system (or a Developer Kit which includes the Runtime Environment), you may download the bin.tar.gz file. Check the prerequisites section 1.2.1 and section 1.2.5 for information on how to start the program.

If you don't have Java installed or you are not sure about it, you should get the jre.tar.gz file. This one contains a complete Java Runtime Environment (jre) so you won't need anything else anymore to run JaxoDraw. Note however the larger size of this last file. Check section 1.2.5 for information on how to start the program.

### 1.2.1 Prerequisites

Note: The following paragraph about the Java environment only applies if you downloaded either the source code src.tar.gz or precompiled binaries bin.tar.gz. The jre version of JaxoDraw includes a Java Runtime Environment, just make sure then that you have enough disc space and memory to run Java programs (a minimum of 128Mb RAM is recommended).

Compilation and execution of JaxoDraw requires an installed and configured Java environment on your system. To execute JaxoDraw you need a Java Runtime Environment (jre), while for compilation you need the Java Developer Kit (jdk, which includes the jre). The program was written with the SUN J2SDK developer kit, version 1.4.1\_01, using the SUN javac compiler. We do not guarantee that the program compiles or runs with any earlier version or any other compiler (but we would like to hear from people who have succeeded to compile and run it on different systems). The Java Developer Kit and Runtime Environment are free software and may be obtained from SUN's web pages<sup>1</sup>. Please refer to SUN's Java pages for information on how to install and configure the Java environment on your system.

In order to profit from the IATEX export file format, you need (apart from a working IATEX distribution, we use TeTeX 1.0.7) J. Vermaseren's axodraw<sup>2</sup> package. This is now distributed along with JaxoDraw (with kind permission of the author) but you have to install axodraw on your system independently of JaxoDraw as described in appendix A. Please refer to the axodraw user guide for documentation on the package.

**Note**: If you have already an axodraw.sty installed on your system, make sure to have a recent version (as the one included in the downloads). Earlier versions did not include some color macros that are necessary for the use with JaxoDraw (see the Bugs section 4.1).

If you want to use the postscript preview option of JaxoDraw, you need to specify an external postscript viewer.

### 1.2.2 Unpacking the archives

Any of the packages available for download are unpacked with the command

```
tar -zxf JaxoDraw-xxx-zzz.tar.gz
```

<sup>1</sup>http://java.sun.com

<sup>2</sup>http://www.nikhef.nl/~form/FORMdistribution/axodraw/

under Linux or with the unzip utility under Windows. Here xxx is the version number and zzz is either src, bin or jre. This will create a directory named JaxoDraw-xxx (the JaxoDraw home directory) in the current directory. For the src distribution the JaxoDraw home directory has the following structure:

src/ Source Files
JaxoDraw/ Binaries
JaxoDraw/icons/ Icons

JaxoDraw/doc/ Documentation (User guide, man pages)

javadoc/ API Specification

where the JaxoDraw/ and javadoc/ directories contain no regular files in the beginning. There are a number of files, like README, BUGS, etc., and some bash shell scripts that may be used to compile and run the program (see below).

The binary bin distribution does not contain any sub-directories but includes an executable .jar file in the JaxoDraw home directory. Also, with respect to the src distribution there are a few files missing that are only required for compilation/documentation issues.

The jre distribution has the same structure as the bin distribution but there is an additional directory j2re1.4.1\_03 (under Linux) or an executable j2re-1\_4\_1\_03-windows-i586.exe (under Windows) containing the Java Runtime Environment.

# 1.2.3 Compiling the sources

If you have downloaded the source distribution of JaxoDraw, the JaxoDraw/ and javadoc/ directories in the JaxoDraw home directory will contain no regular files in the beginning. Under Linux, you compile the sources with

```
javac -d . src/*.java
```

This creates the binary .class files in the JaxoDraw/ sub-directory. In order to create an executable .jar file, issue the command

```
jar -cmf mainclass JaxoDraw.jar JaxoDraw/
```

This creates an executable JaxoDraw.jar file in the JaxoDraw home directory.

Under Windows, the procedure is basically the same as above, just replace the Unix file separator / by the one of Windows: \, and you may have to give the absolute path to the javac and jar executables.

# 1.2.4 Creating the javadoc API specification

**Note:** This is only needed if you are interested in the structure of the JaxoDraw source code, it is not required in order to run the program.

To create javadoc:

```
javadoc -d javadoc/ [-link Java-API] -link . src/*.java
```

where the optional Java-API could be http://java.sun.com/j2se/1.4/docs/api to link against the online Java documentation from SUN, or a local directory if the javadoc is installed locally, for instance:

```
\verb|javadoc -d javadoc/ -link /usr/java/j2sdk1.4.1\_01/docs/api/ -link . src/*.java|
```

In any case, the command has to be run twice in order to get the cross-references right. This will create the javadoc API specification in the javadoc/sub-directory.

# 1.2.5 Running the program

If you compiled the package yourself from sources (see sect. 1.2.3 above), you can start JaxoDraw with the command line

```
java JaxoDraw/JaxoDraw
```

in the distribution home directory, or by

```
java -jar JaxoDraw.jar
```

if you want to use the binary .jar file.

If you downloaded the precompiled binary distribution (.bin), just type

```
java -jar JaxoDraw.jar
```

or under Windows simply double click on the jar file icon.

If you downloaded the .jre distribution and you are using Linux, you have to give the path to the java executable in the j2re directory, typically:

./j2re1.4.1\_03/bin/java -jar JaxoDraw.jar.

Under Windows you simply double click on the j2re-1\_4\_1\_03-windows-i586.exe file to install the Java Runtime Environment, followed by a double click on the jar file icon to start JaxoDraw.

# 1.2.6 Using the shell scripts under Linux

Alternatively to the above procedure, under Linux you may use the bash shell scripts in the JaxoDraw home directory to compile and run the program (provided you have bash and Java installed on your system):

To compile the sources and create the binary classes:

./compile.bsh

To create the API specification:

./doc.bsh [-link Java-API]

where Java-API is the same as in section 1.2.4.

Use the clean.bsh script to delete all binaries and javadoc files:

/clean.bsh

You may give a -all option to this script which will also remove the JaxoDraw.jar file (this may be recreated with the ./compile.bsh script).

Note that compile.bsh, doc.bsh and clean.bsh are only included in the src distribution.

To run the program:

./runme.bsh

or simply

./jaxodraw

(which is a symlink to ./runme.bsh).

### 1.2.7 Installing JaxoDraw system wide

Note: You need root privileges to install JaxoDraw system wide.

Execute the install shell script

./install.bsh

This will put a JaxoDraw-xxx directory into /usr/local, a symlink to the executable bash script into /usr/local/bin and a man page into /usr/local/man/man1 (you may specify different locations by editing the ./install.bsh file). Provided, /usr/local/bin is in your PATH, any user will then be able to run JaxoDraw just by typing jaxodraw. To uninstall, just use the script

./uninstall.bsh

# 1.3 Comments and bug reports

Please send your comments, questions or bug reports to any of our e-mail addresses:

Daniele.Binosi@uv.es

Lukas.Theussl@uv.es

When reporting bugs, you should be as specific as possible about the problem so that we can easily reproduce it. Include some information about your operating system and the version of JaxoDraw that you are using. Include for instance the output of the

```
java JaxoDraw/JaxoDraw --info
and
```

```
java JaxoDraw/JaxoDraw --version
```

commands (this information is also available under the Help menu of the graphical user interface). If you are having problems with the LATEX compilation process, also include detailed information about your LATEX distribution, the version of dvips, your postscript viewer and any other information that may be relevant. Note in particular that there seem to several versions of the axodraw.sty around that are not distinguished by a version number. Some of them present problems when used with JaxoDraw, please try to use the one that we distribute with our program before reporting problems regarding axodraw.

Since we do not maintain a mailing list, we will try to make all messages of general interest available on our Web-site

http://altair.ific.uv.es/~JaxoDraw/home.html

Please check these pages and also the FAQ and Known problems sections of this document before reporting any bugs.

# 1.4 License

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A copy of the GNU General Public License can be found in the file GNU-LICENSE that is distributed along with this program.

JaxoDraw includes a copy of J. Vermaseren's axodraw.sty file (with the kind permission of the author).

The file FORM-LICENSE in the distribution home directory reproduces the author's license agreement as published at

http://www.nikhef.nl/~form/license.html

The .jre version of JaxoDraw includes a copy of the Java Runtime Environment. This is redistributed under the terms of conditions as published at

http://java.sun.com/j2se/1.4.1/j2re-1\_4\_1\_03-license.html

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http://oss.software.ibm.com/icu4j/

PostScript is a trademark of Adobe Systems Incorporated.

# 2 Using JaxoDraw

# 2.1 Terminology

### Object

An object is the collection of points, with optional associated values, that makes up one entity of a Feynman diagram. Examples are blobs, lines, arcs, boxes, loops, etc. The associated values can be used to change the appearance of an object, like color, line width, photon amplitude, and several other features.

#### Graph

A graph is the collection of objects (lines, arcs, ...), together with titles, comments, layout options, etc. drawn to display the Feynman diagram.

### **Parameters**

Parameters are the settings of symbols, line styles, colors, fonts, etc. used to define graphs and the display of the active objects.

# Handles

When the program goes into Edit mode (any mode that allows the modification of any parameters of any object) little red squares are displayed on certain points of every object (for instance on the end points of lines). When the user clicks on one of these handles, the corresponding edit operation is being carried out on the chosen object.

# 2.2 Execution

The most convenient way to start JaxoDraw depends on your operating system and on how you installed the program. See the Installation section 1.2 for generic instructions to run JaxoDraw.

In general, if you compiled the package yourself from sources and put all the binary .class files (together with the doc/ and icons/ sub-folders) in a sub-directory called JaxoDraw/, you can start JaxoDraw by the command

### java JaxoDraw/JaxoDraw

in the current directory. Supposing you have Java installed on your system, this will work on any platform.

# 2.3 Command line parameters

The current version supports the following command line parameters:

#### --version

Prints out the version number of JaxoDraw.

#### --help

Prints out some usage info on the standard output.

### --info

Prints out some information about your system.

#### -verbose

Turns on verbose error messaging (default in the current version).

#### -quiet

Turns off verbose error messaging.

By default, all parameters starting with -- do not pop up the graphical user interface of JaxoDraw.

Furthermore, if you have saved an XML file with a JaxoGraph in an earlier session, you may read in this graph directly on the command line by supplying the file name as an argument (the extension of the file has to be .xml).

# 2.4 Drawing

Drawing Feynman diagrams with JaxoDraw is pretty easy and self-explaining. The program has been designed with the main strategy to be easy to use. In particular, if you are familiar with the xfig¹ program, you will have little problems to get used to JaxoDraw (even though there are a few differences, in particular when drawing arcs, see below). In general, to draw an element of a Feynman diagram, you first choose the drawing mode by clicking on the corresponding button in the button panel, and then draw the object by left mouse-clicking and dragging on the canvas. Drawn objects may then be moved/resized or edited by choosing the corresponding button in the edit button panel and then clicking on one of the handles specifying the object.

A few things to note:

Arcs are always drawn first with a default angle of 180° (a different default angle may be chosen in the Preferences dialog). The angle can then only be changed via the editing menu.

<sup>&</sup>lt;sup>1</sup>http://www.xfig.org/

Any operation that changes any attribute of an object (move, resize, edit, ...) will automatically put the object in the foreground.

It is a good idea to use the refresh button from time to time, especially if there are a lot of objects on the screen and if you are using antialising.

# 2.5 Setting resources

JaxoDraw allows the permanent setting of preferences via the Preferences menu. If you press the "Save" button for the first time in the Preferences dialog, a corresponding preferences file called .Jaxorc will be created in your home directory. This file is read automatically every time JaxoDraw is started. It is in an XML format that may be edited manually if you know what you are doing, the preferred way of editing it is via the above mentioned Preferences menu dialog of the graphical user interface. See the Preferences menu item of section 3.1 for more information on the items that may be saved on a permanent basis.

# 2.6 Colors

In the current version of JaxoDraw, the user may choose from a set of 84 colors that are presented in a convenient color chooser panel if the user clicks an object in color mode. The colors include all the 68 colors defined by the colordvi LATEX class (on a standard TeTeX distribution, these may be found in /usr/share/texmf/tex/plain/dvips/colordvi.tex) and 16 gray scales. If you produce figures with color via the latex -> dvips commands of JaxoDraw, these colors will be used as defined in the colordvi style file. For direct postscript output, we have tried to reproduce as closely as possible the RGB values of these colors, but since there are no complete RGB specifications (for free), the output will not be exactly the same as in the LATEX case.

As a reference, we include two files in the source distribution of JaxoDraw, that illustrate the differences. The latexcolor.ps file in the JaxoDraw/doc/ directory gives a collection of all the colors present in colordvi as produced by latex -> dvips. The file pscolor.ps in the same directory gives the corresponding collection as produced by direct postscript output.

# 2.7 Text

There are two ways of entering text in JaxoDraw: Postscript text mode and LaTeX text mode. Even though they may be used at the same time in a graph, they will appear mutually exclusive in any derived output.

# Postscript text mode

When entering the postscript text mode, the user may enter a text string that will appear directly on the screen and in any direct postscript output (i.e., also in any printer output). It will not appear in any output created via latex -> dvips. In edit mode, the user may choose the text size and font of the text object. A set of Greek characters is available via a syntax that is derived from the corresponding LATEX commands:

$\alpha$	\alpha	$\lambda$	$\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	v	$\upsilon$	$\Lambda$	$\Lambda$
$\beta$	\beta	$\mu$	\mu	$\phi$	\phi	Ξ	\Xi
$\gamma$	\gamma	$\nu$	\nu	$\chi$	\chi	Π	\Pi
$\delta$	\delta	ξ	\xi	$\psi$	\psi	$\sum$	\Sigma
$\epsilon$	\epsilon	o	0	$\omega$	\omega	$\Phi$	\Phi
$\zeta$	\zeta	$\pi$	\pi	$\vartheta$	$\$ vartheta	$\Psi$	\Psi
$\eta$	\eta	$\rho$	\rho	$\varphi$	\varphi	$\Omega$	$\Omega$
$\theta$	\theta	ς	\varsigma	$\Gamma$	\Gamma		
$\iota$	\iota	$\sigma$	\sigma	$\Delta$	\Delta		
$\kappa$	\kappa	au	\tau	Θ	\Theta		

Note that no \$ signs are necessary for these commands (any \$ signs will appear verbatim on the screen). If the user enters a string starting with a "\" that is not recognized as a valid Greek letter, it will be replaced by a question mark "?". In the current version of JaxoDraw it is not possible to do super- or subscripts, this will be implemented in some future version (see the wish list in section 4.2).

# LATEX text mode

When entering the LATEX text mode, the user may enter a text string that will appear only in the LATEX output file and any files created from it via latex -> dvips. Like that all the commands known to LATEX in math mode are available to the user. The position of the text will be marked on the screen by an icon that identifies it as a LATEX text object. This icon does not appear in direct postscript or printing output. Note that the LATEX text string will automatically be put between \$ signs, so the text will always be in LATEX math mode. If you want a normal font in LATEX text mode, you should use {\rm }. Note also that your input here is the only possible source of errors in your LATEX source code. If you get any LATEX compilation errors, check your LATEX text objects first. In edit mode, the user may choose the LATEX font size and the alignment with respect to the current position of the text object.

# 3 Screen elements of JaxoDraw

The screen of JaxoDraw is divided into five main sections:

The menu bar on top

The tool bar just below the menu bar

The button panel on the left

The status bar on bottom

The drawing area (the canvas) in the center

The tool and the status bar may optionally be switched off in the preferences dialog. In the following we will describe each of the above sections in greater detail.

### 3.1 The menu bar

The menu bar contains four main menu bar items: File, Edit, Options and Help.

# File

### New

Starts a new JaxoDraw graph, abandoning the current plot.

#### Open

Open an existing JaxoDraw file, abandoning the current plot. This pops up a file chooser dialog where the user may indicate an XML file that was stored in an earlier session.

#### Save

Save the current plot using the last specified name. If no name is specified, a file chooser menu is popped up. The current graph is then saved in an XML format that may be opened in a later session.

# Save As

The same as Save, but always pops up a file chooser menu to save the current plot under the chosen name.

# Describe

Add a text description to a graph. This will appear as a comment in all output files.

### Export

Pops up a dialog where the user may choose among several export file formats. These ones include: LaTeX -> EPS (to produce an encapsulated postscript (eps) file via latex -> dvips), LaTeX (to produce a text file containing LaTeX source code), Postscript Portrait, Postscript Landscape and EPS (to produce direct postscript output via Java's internal postscript interface in portrait,

landscape and eps format, respectively). Pressing the Export button will pop up a file chooser dialog to enter a file name for the chosen export format.

In addition, there is a button that allows to preview any of the above output formats. Note that in order to preview any of the postscript exports, you will need to indicate a postscript previewer in the preferences dialog (since there is no Java internal postscript renderer). For previewing output in text format, you may still indicate a preferred text editor but if you do not do so, a Java internal text previewer is used by default.

#### Print

Prints the current graph to a specified printer or postscript file. This opens the standard Java printer dialog where any installed and configured printers are detected automatically. Note that printing to a file should be equivalent to the corresponding Export - Postscript option.

# Quit

Exits JaxoDraw.

# Edit

#### Undo

Cancels the last operation. Note that multiple Undo's are not possible.

#### Clear

Clears this graph. This only removes the visible objects from the screen, it does not affect any values associated with the graph.

#### Move

Goes into move mode. Displays handles where the user may grab an object and move it by dragging it over the screen.

### Resize

Goes into Resize mode. Displays handles where the user may grab an object and resize it by dragging a specified point. Note that loops and arcs cannot be resized from the center point.

# Copy

Goes into Copy mode. Displays handles where the user may grab an object that will be duplicated by an exact copy that the user may drag to a different location.

# Color

Goes into Color mode. Displays handles where the user may grab an object which pops up a dialog to change the color of the object. See section 2.6 for more information on colors.

# Edit

Goes into Edit mode. Displays handles where the user may grab an object which pops up a dialog to change the parameters of the object. Which parameters may be edited depends on the object.

#### Delete

Goes into Delete mode. Displays handles where the user may grab an object to delete it.

## Background

Goes into Background mode. Displays handles where the user may grab an object to put it into the background.

# Foreground

Goes into Foreground mode. Displays handles where the user may grab an object to put it into the foreground.

# Options

### Look and Feel

Lets the user choose a Look and Feel for the current session. Note that some LAFs may not be available on your system and that there might be differences in some layouts, in particular with icons in the tool bar.

# Vertex types

Lets the user choose the type of vertex to be drawn when in Vertex mode. By default, it is a black dot, other vertices currently supported are a circle with a cross, a square and a cross. Choosing one vertex type will change the icon of the Vertex button in the button panel to the corresponding vertex.

### **Show Toolbar**

Lets the user choose whether the toolbar is visible or not.

#### **Show Statusbar**

Lets the user choose whether the statusbar is visible or not.

#### Antialias on

Lets the user choose whether to use antialiasing or not. The graphics quality is usually better with antialiasing turned on. This goes with the cost that graphics rendering may be slower on some machines and you may need to refresh the screen from time to time, especially after a number of editing operations.

#### Arrow

Lets the user choose whether arrows should be drawn on all objects that support them.

#### **Preferences**

Pops up a dialog where the user may choose several settings to be saved on a permanent basis. The first group of settings are the default HTML viewer (to view the JaxoDraw documentation in HTML format), a default text editor (used for previewing LATEX text output) and a default postscript viewer (used for previewing the printer or direct postscript output). Note that you need to specify a default postscript viewer in order to view postscript files from within JaxoDraw because Java does not have an internal possibility to render postscript files. Contrary to that, if you do not specify any default HTML viewer or text editor, previews will still be possible with the Java internal HTML and text rendering mechanisms which will be used by default.

You may then choose the default Look and Feel, the default size of the grid, the default line width, the default opening angle for arcs, as well as the initial screen size. Finally you may determine whether the tool- and the status bar are visible by default, whether antialiasing should be used by default and whether arrows should be drawn by default on all objects that support them.

Clicking OK will apply the specified values for the current session without saving them in the system configuration file <code>.Jaxorc</code>, clicking Save will save the settings without applying them to the current session, the button Clear only clears the text fields of the default previewers, Reset restores all the values to their current default settings and Cancel closes the Preferences dialog without applying any changes.

See section 2.5 for more information on setting resources.

# Help

#### About

Gives some information about the version of JaxoDraw you are using.

# User guide

Pops up a new window with this user guide in HTML format. If a default HTML viewer has been chosen in the Preferences dialog, it will be used, otherwise a Java internal previewer is used by default.

### System info

Gives some information about your system (current user, operating system, Java installation).

# 3.2 The tool bar

The tool bar may be switched on and off in the Options menu item. If it is switched on, the tool bar contains icons whose action is identical to the corresponding menu entries: New, Open, Save, Save As, Describe, Export, Print. There is furthermore one icon that does a Latex -> EPS preview, and on the right there is an icon to pop up the user guide.

# 3.3 The button panel

The button panel on the left of the screen is divided into the following subsections:

Particle buttons There is one button for each particle type: fermion (straight line), scalar (dashed line), ghost (dotted line), photon (wiggled line) and gluon (pig-tailed line); and the three object types: lines, arcs and loops. When one of these buttons is clicked the program goes into the corresponding drawing mode, i.e., no handles are shown on the screen and the user may click on the canvas to start drawing the corresponding object.

Miscellaneous buttons There are buttons for drawing blobs (ellipses), boxes, vertices and zig-zag lines, as well as buttons that allow the insertion of postscript text and LATEX text into the graph. See section 2.7 above for information on postscript- and LATEX text mode. When one of these buttons is clicked the program goes into the corresponding drawing mode.

**Action buttons** These are the buttons that lead to an immediate action: Undo and Clear have the same effect as the corresponding entries in the Edit menu, while the Refresh button leads to a redrawing of the screen. This is especially useful if antialising is used.

**Edit buttons** There are a number of buttons (Move, Resize, Copy, Color, Edit, Delete, Background and Foreground) whose actions are equivalent to the ones described in the Edit menu panel section. When one of these buttons is clicked the program goes into the corresponding edit mode.

**Grid and exit button** The grid button turns on the grid so that the user can choose only certain points for placing his objects. Note that this will not change any objects already present on the screen. The exit button quits JaxoDraw.

# 3.4 The status bar

The status bar may be switched on and off in the Options menu item. If it is switched on, the status bar contains three areas: one to display the current file (if any), one to display the current drawing mode and one that displays the current coordinates of the cursor on the canvas.

# 3.5 The canvas

This is the main drawing area. After choosing a drawing mode from the button panel, the user may draw the corresponding object by left-clicking and dragging on the canvas.

# 4 Known problems and limitations

This section gives a list of bugs and limitations that were known at the time of first publication of JaxoDraw-1.0. Please check the Bugs section of our Web page<sup>1</sup> for an updated version of this document. Note that not all points are necessarily real bugs, we regard this just as a collection of features that do not work exactly the way we would like to.

<sup>&</sup>lt;sup>1</sup>http://altair.ific.uv.es/~JaxoDraw/bugs.html

# 4.1 Bugs

- \* If a LATEX text file is previewed with the Java internal previewer (i.e. without having set a custom previewer in the preferences), the page displays but cannot be scrolled. When the export chooser menu is closed, it becomes scrollable (this may be used as a workaround).
- \* Choosing a different Look and Feel in the Preferences dialog of the Options menu item and pressing the OK button, does not update the Look and Feel of the current session. Workaround: use the Look and Feel dialog of the Options menu instead.
- \* When using IBM's Runtime Environment, the program may be executed and works fine for most parts but presents some peculiarities: the layout of pop up windows is not always the same and XML output serializes the bounding boxes of objects that are explicitly marked as transient in the source code. This has been reported to us for version number 1.4.1 of IBM's SDK. For us, this appears to be an incompatibility between SUN's and IBM's Runtime Environments. On the other hand, the program compiles fine with IBM's jikes compiler (tested with version 1.13).
- \* If your LATEX compilations give errors complaining about unknown commands like \SetColor{}, you will probably have to update your axodraw.sty file to a more recent version (the one included in our distribution will work).
- \* There is a bug in axodraw concerning gluon loops. In fact there is no command for drawing gluon loops, but if you draw a gluon arc with 360°, then the gluon wiggles do not close correctly. Since this is a bug in axodraw, there is no workaround except not to use gluon loops, or, if you need nicely closing loops, to use the direct postscript output of JaxoDraw.
- \* Running an internal IATEX compilation without axodraw installed (or IATEX in the case you are a Windows user), will hang the program. Please check appendix A for information about installing axodraw.

# 4.2 Wish list

The following are requested features that we will hopefully implement in a future version of JaxoDraw:

- \* Enhance the TextParser class to allow sub- and superscripts in text objects
- \* Implement a triangle vertex
- \* Improve the drawing of arcs
- \* Let the user include custom packages in the LATEX output
- \* Add the possibility to move/copy a group of objects
- \* Allow to work with several graphs at a time
- \* Show the LATEX text in a pop-up window when rolled over

# 5 Documentation

This section gives a list of hints and tricks as well as a list of frequently asked questions that were known at the time of first publication of JaxoDraw-1.0. Please check the Docs section of our Web page<sup>1</sup>, for an updated version of this document.

<sup>&</sup>lt;sup>1</sup>http://altair.ific.uv.es/~JaxoDraw/docs.html

# 5.1 Tips and tricks

- \* Note that postscript files produced by Export EPS are considerably larger in size than the same files generated via latex -> dvips. This is due to the way how Java handles the postscript printing internally. Keep this in mind if you want to include a bunch of small figures in your document: it is then probably preferable to use the LATEX output.
- \* It is a good idea to use the refresh button from time to time, especially if there are a lot of objects on the screen and if you are using antialising.
- \* Instead of producing EPS figures and including them into your document, you may as well cut-and-paste the LATEX output of JaxoDraw into your own LATEX source code. Like that you may avoid the proliferation of numerous postscript files to be distributed with your source code. Note however that you will have to include axodraw in the header of your LATEX file (put \usepackage{axodraw} somewhere before \begin{document}) and you will probably have to distribute the axodraw.sty file along with your source code because it is not part of any standard LATEX distribution.
- \* To add multiple arrows to objects (such as loops, for example), or to draw arrows on objects that do not support them (photon and gluon objects in particular), use fermion lines with very small length (5 points should do the job). Use the edit menu, to give the arrow the inclination you need and then move it to the wanted location.

# 5.2 FAQ

No questions so far ...

# 6 History

1.9.2003 Released JaxoDraw-1.0

# 7 Credits

We are grateful to Prof. Arcadi Santamaria for numerous helpful remarks and moral support during the development of JaxoDraw. We also acknowledge Prof. Jos Vermaseren for his kind permission to use and distribute his axodraw style file along with JaxoDraw.

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# A Installing axodraw.sty

Note: It is not necessary to install axodraw in order to run JaxoDraw. You will just not be able to use the LaTeX/LaTeX - EPS export options but you may still generate direct postscript output of your Feynman diagrams. Beware however that in the current version, trying to run an internal LaTeX compilation without axodraw installed, will hang the program. See the Bugs section 4.1.

In the current version of JaxoDraw we distribute a copy of J. Vermaseren's axodraw package (with kind permission of the author) in the distribution home directory. You have to install axodraw.sty such that LATEX can find it on your system. This appendix describes how to do that.

First get J. Vermaseren's axodraw package from

http://www.nikhef.nl/~form/FORMdistribution/axodraw/

or from the JaxoDraw distribution home directory. Please refer to the axodraw user guide for a detailed documentation of the package. We shall only outline here how you make axodraw available on your system and how you use it with the LATEX output from JaxoDraw.

# A.1 Linux instructions

For installation, you have two options: if you intend to use axodraw just for yourself on a multi-user platform, you may install it locally; if you want to make it available for all the users on the system, you should do a global installation. Note that you will need root privileges for a global installation.

# Installing axodraw locally

The easiest way to use axodraw is to put the axodraw.sty file in the same directory as your LATEX source file (like the one produced by JaxoDraw via the Export -> LaTeX command). This is usually the same directory where you execute the program (but note that you cannot execute JaxoDraw from a different directory in this case). You can then run latex on your source file as usual, the style file will be found because the current directory is by default in the TEXINPUTS search path.

An alternative (better) way is to put the style file in a special directory (this is particularly useful if you have several style files which are not part of your standard LATEX distribution). Let's say you put it into the directory latex/ in your home directory. You then have to set the TEXINPUTS variable to this path. If you are using bash, just do

### export TEXINPUTS=\$HOME/latex//:

(the //: at the end tells LATEX also to look into sub-directories of this path). If you want to make that permanent, you should put this line into your .bashrc file. You will then be able to start JaxoDraw from any directory, independently of the location of axodraw.sty.

### Installing axodraw system-wide

Installing axodraw system wide is very easy. Just put the style file somewhere in the global search path of your IATEX distribution (on Redhat Linux typically /usr/share/texmf/tex/latex/misc/) and update the TEX database with

### mktexlsr

(you will have to be root for doing this).

# A.2 Windows instructions

Under Windows, you have to do basically the same as under Linux. First put your axodraw.sty file into the MikTeX search tree (somewhere under /texmf/tex/latex/, replace the slash by a backslash!) and update your database with the command mktexlsr in the /texmf/tex/miktex/bin directory.

# References

- [1] M. J. S. Levine, A LaTeX graphics routine for drawing Feynman diagrams, Comput. Phys. Commun. 58 (1990) 181–198.
- [2] J. A. M. Vermaseren, Axodraw, Comput. Phys. Commun. 83 (1994) 45–58.
- [3] T. Ohl, Drawing Feynman diagrams with Latex and Metafont, Comput. Phys. Commun. 90 (1995) 340–354.